

## CLAIMS

I claim:

1. A circuit for controlling an ac machine having a stator with stator windings and a rotor, the circuit comprising:

a full bridge network of commutation switches which are connected to supply at least one phase voltage to the stator windings;

a plurality of diodes, each in parallel connection to a respective one of the commutation switches for allowing conduction of current in a reverse direction to bypass each respective commutation switch;

a plurality of dc source connections for receiving a plurality of incremental dc voltages and for applying a selected sum of said incremental dc voltages to said full bridge network of commutation switches over successive time intervals to approximate a sinusoidal voltage; and

a controller connected for control of said dc source connections and said full bridge network of commutation switches to output a substantially sinusoidal phase voltage to the stator windings.

2. The circuit of claim 1, wherein the dc source connections comprise at least one diode-clamped phase leg for providing multiple levels of dc bus voltage.

3. The circuit of claim 1, wherein the dc source connections comprise at least one flying capacitor phase leg for providing multiple levels of dc bus voltage.

4. The circuit of claim 1, wherein dc source connections comprise a plurality of half-bridge cells connected in series, each cell having a corresponding dc source.

5. The circuit of claim 4, wherein at least one of the plurality of half-bridge cells has a different level of dc source voltage than other half-bridge cells in the plurality of cells.

6. The circuit of claim 1, wherein the dc source connections each have a plurality of switches, and wherein said switches are operated by the controller for producing pulse width modulation signals to a load.

7. The circuit of claim 1, wherein each of the plurality of cells has a plurality of dc source voltage levels.

8. The circuit of claim 1, wherein the incremental dc voltages are not all equal.

9. The circuit of claim 1, wherein for a plurality of dc incremental dc voltages =  $m$ , the commutation switches and the switches included in the dc source connections =  $m+3$ .

10. A polyphase control circuit for controlling an ac machine having a stator with stator windings and a rotor, the control circuit comprising:

a plurality of full bridge networks of commutation switches which are connected to apply corresponding phase voltages to the stator windings;

a plurality of diodes, each in parallel connection to a respective one of commutation switches for allowing conduction of current in a reverse direction to bypass each respective commutation switch;

a plurality of dc source connections for receiving a plurality of incremental dc voltages and for applying a selected sum of said incremental dc voltages to said full bridge networks of commutation switches over successive time intervals to provide approximately sinusoidal phase voltages; and

the polyphase control circuit further comprising a controller connected for control of said dc source connections and said full bridge networks of commutation switches for each of the phase voltages to output substantially sinusoidal phase voltages to the stator windings.

11. The circuit of claim 10, wherein the dc source connections for each of the phase voltages comprise at least one diode-clamped phase leg for providing multiple levels of dc bus voltage, and wherein the dc source connections for each of the phase voltages include a corresponding dc source.

12. The circuit of claim 10, wherein the dc source connections for each of the phase voltages comprise at least one diode-clamped phase leg for providing multiple levels of

dc bus voltage, and wherein the dc source connections for each of the phase voltages receive dc voltage from a common dc source.

13. The circuit of claim 10, wherein the dc source connections for each of the phase voltages comprise at least one flying capacitor phase leg for providing multiple levels of dc bus voltage, and wherein the dc source connections for each of the phase voltages includes a corresponding dc source.

14. The circuit of claim 10, wherein the dc source connections for each of the phase voltages comprise at least one flying capacitor phase leg for providing multiple levels of dc bus voltage, and wherein the dc source connections for each of the phase voltages, and wherein the dc source connections for each of the phase voltages receive dc voltage from a common dc source.

15. The circuit of claim 10, wherein dc source connections for each phase comprise a plurality of half-bridge cells connected in series, each cell including a corresponding dc source.

16. A method of controlling an ac machine having a stator with stator windings and a rotor, the circuit comprising:

turning on in sequence a full bridge network of primary commutation switches connected to apply a phase voltage to the stator windings of the machine, said switches being turned on and off so as to produce a positive half cycle and a negative half cycle of said phase voltage;

producing a plurality of incremental dc voltages; and

applying a varying sum of the plurality of incremental dc voltages to said plurality of commutation switches to apply an approximately sinusoidal phase voltage having a positive half cycle and a negative half cycle.

17. The method of claim 16, further comprising dividing a dc voltage from an external dc voltage source into incremental dc voltages.

18. The method of claim 17, wherein the dc voltage is divided by a plurality of clamping diodes connected across selected semiconductor switches in a series of semiconductor switches.

19. The method of claim 17, wherein the dc voltage is divided by a plurality of clamping capacitors connected across selected semiconductor switches in a series of semiconductor switches.

20. The method of claim 16, further comprising:  
providing a plurality of dc voltages sources;  
producing a plurality of incremental dc voltages from each of said plurality of dc voltage sources; and  
applying a varying sum of the plurality of incremental dc voltages to said plurality of commutation switches.